

State Energy Data Report 1997

Consumption Estimates

September 1999

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Office of Energy Markets and End Use
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State Energy Data Report 1997

Consumption Estimates

The *State Energy Data Report 1997* presents estimates of annual energy consumption at the State and national levels by major economic sector and by principal energy type for 1960, 1965, 1970, 1975, 1980, and 1985 through 1997. Included in the report are documentation describing how the estimates were made for each type of energy, the source references for all input data, and a summary of changes from the *State Energy Data Report 1996*, which was published in February 1999.

Publication of this report is in keeping with responsibilities given to the Energy Information Administration (EIA) in Public Law 95-91 (Department of Energy Organization Act), which states, in part, in Section 205(a)(2), that:

The Administrator shall be responsible for carrying out a central, comprehensive, and unified energy data and information program which will collect, evaluate, assemble, analyze, and disseminate data and information....

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The report and data are also available on EIA's **CD-ROM**, the *Energy InfoDisc*, along with over 200 other EIA reports, databases, and models. For more information, call NEIC, or to order, call 1-800-STAT-USA.

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Introduction

Purpose

The *State Energy Data Report (SEDR)* provides annual time series estimates of State-level energy consumption by major economic sectors. The estimates are developed in the Combined State Energy Data System (CSEDS), which is maintained and operated by the Energy Information Administration (EIA). The goal in maintaining CSEDS is to create historical time series of energy consumption by State that are defined as consistently as possible over time and across sectors. CSEDS exists for two principal reasons: (1) to provide State energy consumption estimates to Members of Congress, Federal and State agencies, and the general public and (2) to provide the historical series necessary for EIA's energy models.

System and Report

Efforts are made to ensure that the sums of the State data equal the national totals as closely as possible for each energy type and end-use sector as published in other EIA publications. Estimates in this *State Energy Data Report (SEDR)* are generally comparable to the statistics in the *Annual Energy Review 1998* and the *Monthly Energy Review*, March 1999.

Due to page-size constraints, *SEDR* tables show data for selected years from 1960 through 1984; however, data for all years 1960 forward are maintained in CSEDS, are included in the data files available via Internet, and are covered by the documentation in this report.

Extensive documentation follows the data tables in this report. Appendix A describes how the estimates were derived for each individual energy source and lists the sources of all data series. Appendix B lists alphabetically all of the variable names and formulas used. Appendix C lists the

conversion factors used to convert physical units into British thermal units and cites the sources for those factors. Appendix D provides the State resident population statistics that are used in per capita calculations. Appendix E provides metric and other physical conversion factors for measures used in energy analyses. Appendix F contains carbon dioxide emission factors. Appendix G summarizes the changes made since the last report, which was released in February 1999. Appendix H lists other EIA reports containing State-level data.

Improvements

Several renewable energy sources have been added to the database in this update. Estimates of wood energy consumed in the residential, commercial, and industrial sectors from 1960 through 1989 are now included. Direct use of geothermal energy and energy derived from the use of heat pumps in the residential, commercial, and industrial sectors are also added for 1989 forward. Several energy sources previously had been included for 1990 forward—solar energy estimates in the residential (including commercial) sector, industrial use of hydroelectricity, and geothermal, solar and wind energy, and transportation consumption of ethanol—now have 1989 data as well.

The method used to estimate State-level commercial wood consumption for 1990 forward is revised to be consistent with the estimation methodology for the new commercial wood consumption estimates added for 1960 through 1989.

Appendix G. Detailed information about all data revisions in this edition of *SEDR* is contained in Appendix G. All data with revisions since the last edition of CSEDS that are large enough to be seen in the report tables' level of rounding are preceded with an "R" in the report tables.

Data

Estimation Methodologies. CSEDS develops estimates of energy consumption by principal energy sources and major end-use sectors, by State, for a 38-year period. Energy consumption is estimated by using data from existing surveys of energy suppliers that report consumption, sales, or

distribution of energy at the State level. Most of the CSEDS estimates rely directly on collected State-level consumption data. (See box below that summarizes the status of current data sources used.) Some consumption estimates in CSEDS are based on a variety of surrogate measures. The measures were selected principally on the basis of applicability as an indicator of consumption, availability, continuity over time, and consistency. For instance, for petroleum, “product supplied” is a surrogate for

Collected Data and Estimated Values in CSEDS

Coal. U.S. anthracite, bituminous coal and lignite, and total coal consumption data by sector are taken directly from EIA’s *Quarterly Coal Report (QCR)* or are unpublished data from EIA’s Weekly Coal Production database. Total coal consumption by State and for most sectors is from the *QCR*, except where values are withheld and must be estimated. The State-level disaggregation of the *QCR*’s combined residential and commercial sector and the combined anthracite and bituminous coal and lignite use in all sectors (except electric utilities) are estimates. Data on electric utility coal consumption by State and coal type are data from the Form EIA-759, “Monthly Power Plant Report,” database.

Natural Gas. Natural gas consumption by State and sector come directly from the EIA’s *Natural Gas Annual (NGA)*. Natural gas consumed as lease fuel and plant fuel and natural gas delivered to industrial consumers are combined in CSEDS as industrial sector consumption. Natural gas consumed as vehicle fuel and pipeline fuel are combined in CSEDS as transportation sector consumption.

Petroleum. U.S. total consumption for each petroleum product is the “product supplied” data from EIA’s *Petroleum Supply Annual*. State values for distillate fuel and residual fuel consumption at electric utilities are unpublished data from EIA’s Form EIA-759 database. All other State and sector values for consumption of petroleum products are estimates based on sales data from several sources.

Renewable Energy. • Residential and commercial sectors consumption of wood, geothermal, and solar energy are estimated. • Industrial consumption of hydroelectric power is data collected by the Federal Power Commission for 1960 through 1978, CSEDS’ estimates for 1979 through 1989, and data collected by EIA on Form EIA-867, “Annual Nonutility Power Producer Report,” for nonutility power production for 1990 forward. Industrial consumption of geothermal, wind, solar thermal, and photovoltaic energy is collected on the Form EIA-867. An additional portion of industrial consumption of wood, waste, and geothermal energy is estimated. • State-level transportation use of ethanol is estimated, although the U.S. data are collected on several forms and reported in EIA’s *Renewable Energy Annual*. • All sources of renewable energy used for electricity generation at electric utilities (i.e., wood and waste, hydroelectric power, geothermal, wind, solar thermal, and photovoltaic energy) by State are from EIA’s *Electric Power Annual (EPA)* or are unpublished data from the Form EIA-759 database.

Nuclear Electric Power. Nuclear electricity generation by State is from the *EPA*.

Electricity. Electricity consumption is sales data by sector and State from the *EPA* with one exception. The *EPA* “Other” category is allocated to the transportation and commercial sectors in each State by estimation.

Electrical System Energy Losses and Net Interstate Flow of Electricity. These series are estimated in CSEDS.

consumption and is derived by summing field and refinery production, plus imports, minus exports, plus or minus changes in stocks. State-level sales survey data are used to disaggregate the national petroleum product supplied totals to the States. The measures of consumption and estimation methodologies are explained in detail under each energy source in Appendix A.

Methods are also applied to estimate State electrical system energy losses that are not available from any survey. See the box below for a discussion about losses and how they are reflected in *SEDR* tables. U.S. total

electrical system energy losses are allocated to each individual State's end-use sectors in proportion to the sectors' electricity sales. The estimation method does not separately identify electrical system energy losses from interstate flow of electricity. Therefore, specific estimates are developed for Alaska and Hawaii and for the 48 contiguous States. The Electricity section of Appendix A on page 425 explains the methodology in detail. EIA is examining a method to disaggregate the estimates of net interstate flow of electricity and electrical system energy losses that are currently combined. The explanation and Tables A 10 through A21 in the Electricity

Energy Consumption Measures—Total and Site

Sources of energy can be categorized as primary and secondary. Primary sources of energy, such as coal, petroleum, and natural gas are consumed directly. Electricity is a secondary form of energy that is created from primary energy sources. The amount of electricity actually consumed by the end user (site consumption) does not include the energy lost in the generation and delivery of the electricity to the point of use.

Primary sources of energy are measured in applicable physical units. Coal is measured by the short ton (equal to 2,000 pounds); petroleum, by the barrel (equivalent to 42 gallons); and natural gas, by the cubic foot. Energy sources are also measured by their heat content, generally expressed in British thermal units (Btu). For example, in 1997, the average short ton of bituminous coal and lignite consumed at electric utilities contained 20.6 million Btu (Table C13), the average barrel of distillate fuel contained 5.825 million Btu (page 494), and the average cubic foot of natural gas consumed at electric utilities contained 1,018 Btu (Table C3).

Electricity, a secondary form of energy, can also be measured in physical units, commonly kilowatthours, and by heat content. The

conventional thermal conversion factor for electricity consumed by the end user (site consumption) is 3,412 Btu per kilowatthour.

Table A10 on page 430 shows that electric utilities consumed 32.6 quadrillion Btu of primary energy in 1997 in order to provide 10.0 quadrillion Btu of electricity for sale. These data indicate that 67 percent of the primary (embodied) energy in the fuels consumed to generate the electricity was used (or "lost") in converting the primary energy to electricity and transmitting and distributing the electricity to the consumers, and 33 percent was used as site (point-of-use) electricity by consumers.

In evaluating energy consumption in this report, tables titled "Total Energy Consumption" include all primary energy sources, including those used to generate electricity; the electricity generated is not included. Tables showing "Total End-Use Sector Consumption" include columns for the primary sources and electricity that are consumed by the sector, as well as a column for the estimated energy lost in the electrical system processes. The "Total" column in those tables includes all energy consumed by the sector and the associated energy lost in the generation and transmission of electricity. The column titled "Net" is site energy consumption—that is, the sum of the primary sources and electricity, excluding the electrical system energy losses.

section of Appendix A (pages 428–441) discuss and illustrate the alternative methodology.

Data Sources. The original source documents cited in Appendix A include descriptions of the data collection methodologies, universes, imputation or adjustment techniques (if any), and errors associated with the processes. Due to the numerous collection forms and procedures associated with those reports, it is not possible to develop a meaningful numerical estimate of the overall errors of the integrated data published here.

Reliable, consistent series for long periods of time—especially in the earlier years—are difficult to develop, and estimates and assumptions must be applied to fill data gaps and to maintain definitional consistency. Although CSEDS incorporates the most consistent series and procedures possible, users of this report should recognize the limitations of the data that are due to changing and inadequate data sources.

In reports prepared by the Bureau of Mines in the late 1960's and early 1970's, petroleum consumption was equated to demand. Later, consumption was equated to apparent demand and, more recently, to product supplied. Changes in surveys and reduction of data collections, especially after 1978, disturbed the continuity of some petroleum consumption series, most notably for distillate fuel, residual fuel, kerosene, and liquefied petroleum gases. These and other data inconsistencies are explained in detail under "Additional Notes" for each energy source in Appendix A. All data series with recognized data inconsistencies are footnoted in the *SEDR* tables.

Comparison with Other Energy Consumption Reports

EIA conducts numerous energy-related surveys. In general, the surveys can be divided into two broad groups. One group of surveys, called supply surveys, is directed to the suppliers and marketers of specific energy sources. Those surveys measure the quantities of specific fuels supplied to the market. The results of supply surveys are combined and published in a number of EIA publications, including the *Monthly Energy Review* and *SEDR*. The second group of surveys, called energy consumption surveys, gathers information directly from end users of energy. Although there are some elements in common, the supply survey data and the consumption

survey data have substantially different approaches, capabilities, and objectives. Thus, care must be taken in analyzing *SEDR* data in conjunction with consumption survey data for the following reasons:

- *SEDR* is designed to be a broad accounting of energy consumption, covering all energy use and splitting it into major sectors as clearly as possible. The energy consumption surveys are designed to be comprehensive and representative within individual sectors. However, the sectors are restricted for purposes of creating relatively homogeneous, well-defined populations and for aiding in sampling and data collection. For example, the Residential Transportation Energy Consumption Survey covers only household vehicles; CSEDS covers all uses of energy for transportation of persons and commodities. Similarly, the Commercial Buildings Energy Consumption Survey covers only energy consumption in commercial buildings, while CSEDS includes other commercial consumption, such as street lighting and public services; and the Manufacturing Energy Consumption Survey covers only manufacturing establishments, while CSEDS includes other industrial energy consumption (i.e., mining, construction, agriculture, fisheries, and forestry). Further, the consumption surveys do not cover all energy-using sectors. Therefore, energy consumption surveys cannot be summed together to account for all energy use.
- Energy consumption surveys provide user characteristics that allow for both macro-level (for major sectoral sub-populations) and micro-level (at the unit of data collection) interpretive analysis. The surveys of energy consumption by residential households from the Residential Energy Consumption Survey (Form EIA-457 series), for personal transportation from the Residential Transportation Energy Consumption Survey (Form EIA-876 series), and by commercial buildings from the Commercial Buildings Energy Consumption Survey (Form EIA-871 series) provide detailed information about the energy end users, their size, their stock of energy-consuming equipment and appliances, and their total energy consumption and expenditures. The Manufacturing Energy Consumption Survey (Form EIA-846 series) collects consumption by type of use and fuel switching capability from manufacturing establishments grouped by manufacturing classification. CSEDS, on the other hand, provides limited characterization of the end users of energy but greater geographic and energy product detail, as well as annual historical time series.

- Sectoral classification in CSEDS is generally based on supplier classifications of customer accounts, by whatever means suppliers choose to use. (See discussion in next section.) Sectoral classification for the energy consumption surveys is based upon a categorization, verified by end user, of the primary economic activity of the data collection unit (household, vehicle, building, or establishment).
- The energy consumption surveys provide data at national and Census region and/or Census division levels, whereas the estimates in CSEDS are on national and State levels.
- The reference periods are also different in that CSEDS covers calendar years from 1960 through 1997, while the consumption surveys are for selected years, and the residential end-use surveys taken prior to 1987 cover a heating season year (i.e., April through March). Beginning with the 1987 residential end-use survey, the reference period is a calendar year.

For a more detailed description of the differences between CSEDS and the energy consumption surveys, see the EIA analysis report *Energy Consumption by End-Use Sector: A Comparison of Measures by Consumption and Supply Surveys*, DOE/EIA-0533, April 1990.

Energy Consuming Sectors

The consumption estimates in CSEDS are based on data collected by various surveys that do not necessarily define the consuming sectors exactly the same way. Appendix A of this report describes in detail for each energy source how the collected data series are combined and assigned to CSEDS consuming sectors. To the degree possible, energy consumption in this report has been assigned to the five sectors according to the following general definitions:

- The **residential sector** is considered to consist of all private residences, whether occupied or vacant, owned or rented, including single-family homes, multifamily housing units, and mobile homes. Secondary homes, such as summer homes, are also included. Institutional housing, such as school dormitories, hospitals, and military

barracks, generally are not included in the residential sector; they are included in the commercial sector.

- The **commercial sector**, as defined economically, consists of business establishments that are not engaged in transportation or in manufacturing or other types of industrial activity (agriculture, mining, or construction). Commercial establishments include hotels, motels, restaurants, wholesale businesses, retail stores, laundries, and other service enterprises; religious and nonprofit organizations; health, social, and educational institutions; and Federal, State, and local governments. Street lights, pumps, bridges, and public services are also included if the establishment operating them is considered commercial.
- The **industrial sector** comprises manufacturing industries, which make up the largest part of the sector, along with mining, construction, agriculture, fisheries, and forestry. Establishments in this sector range from steel mills to small farms to companies assembling electronic components.
- The **transportation sector** consists of private and public vehicles that move people and commodities. Included are automobiles, trucks, buses, motorcycles, railroads and railways (including streetcars), aircraft, ships, barges, and natural gas pipelines.
- The **electric utility sector** consists of privately and publicly owned establishments that generate, transmit, distribute, or sell electricity primarily for use by the public and that meet the definition of an electric utility. Nonutility power producers are not included in the electric utility sector.

Sector Definition Discrepancies. Although the end-use allocations are made according to these aggregations as closely as possible, some data are collected by using different classifications. For example, electric utilities may classify commercial and industrial users by the quantity of electricity purchased rather than by the business activity of the purchaser. Natural gas used in agriculture, forestry, and fisheries was collected and reported in the commercial sector through 1995. Beginning with 1996 data, deliveries of natural gas for agriculture, forestry, and fisheries are reported in the industrial sector instead. Another example is master-metered condominiums and apartments and buildings with a combination of residential and

commercial units. In many cases, the metering and billing practices cause residential energy usage of electricity, natural gas, or fuel oil to be included in the commercial sector. No adjustments for these discrepancies were made.

CSEDS does not provide further disaggregated end-use consumption estimates. For example, the industrial sector cannot be broken down into the chemical or rubber industries, all manufacturing, or agriculture. The input series for the system are provided in broad end-use categories from the data collection forms and are not available by the individual components. Additional disaggregated regional information, such as counties or cities, are also not available from CSEDS.